

Paper-- REMOTE SENSING, GIS AND GPS

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Topic:- Unit-1 (CONCEPT AND PRINCIPLES OF REMOTE SENSING SYSTEM)

BY

BIKASHITA KALITA

Lecturer in the Department of Geography

Moirabari College, Morigaon

Meaning of remote sensing(सुदूर संवेदन का अर्थ)

- remote sensing means, process of acquiring information of things from a distance .
- of our five senses, we use three as remote sensors when we
 - 1) sense of sight
 - 2) sense of smell
 - 3) sense of hearing
 - 4) sense of touch
 - 5) sense of taste

Remote sensing(सुदूर संवेदन)

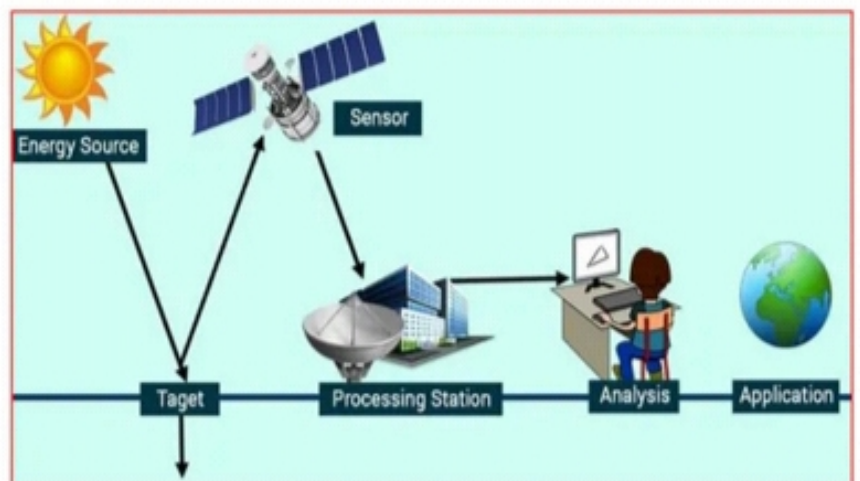
- remote sensing is the technique of deriving information about objects on the surface of the earth, without physically coming into connect with them. (NRSA- National Remote Sensing Agency) 1995

Data in remote sensing(सुदूर संवेदन में डाटा)

- **Data** are characteristics or information, usually numerical, that are collected through observation. In a more technical sense, data is a set of values of qualitative or quantitative variables about one or more persons or objects.
- **In-situ data** - data that are collected directly in the field are termed as In-situ data .
- **Remote sensing data** – the data that collected remotely called RSD. *(useful for RS)*

Difference between remote sensing, GIS & remote sensor (रिमोट सेंसिंग, जीआईएस और रिमोट सेंसर के बीच अंतर)

- Remote sensing – Process
- GIS – complete system
- Remote sensor – Device



Remote sensing process(सुदूर संवेदन प्रक्रिया)

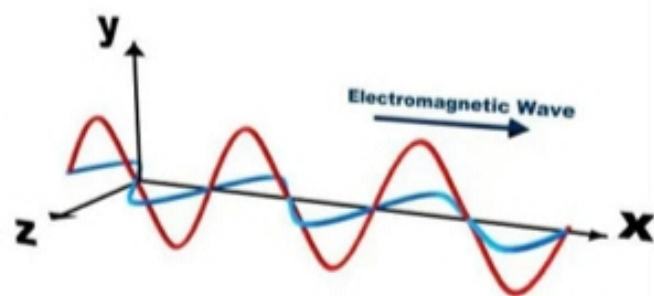
1. Radiation by energy source (ऊर्जा स्रोत द्वारा विकिरण)
2. Interaction with the earth's atmosphere (पृथ्वी के वायुमंडल के साथ अन्तरक्रिया)
3. Interaction with the target (लक्ष्य के साथ अन्तरक्रिया)
4. Recording of energy by the sensor (सेंसर द्वारा ऊर्जा की रिकॉर्डिंग)
5. Transmission, reception and processing (संचरण, स्वागत और प्रसंस्करण)
6. Interpretation and analysis (व्याख्या और विश्लेषण)
7. Application (अनुप्रयोग)

Concept of Energy(ऊर्जा की संकल्पना)

- the three basic ways in which energy can be transferred include,
 1. **Conduction**(in molecule or atom),
 2. **Convection**(physical movement of energy of body) and
 3. **Radiation**(vacuum) – is the primary interest to RS because it is only form of energy that can transfer between sun and the earth.

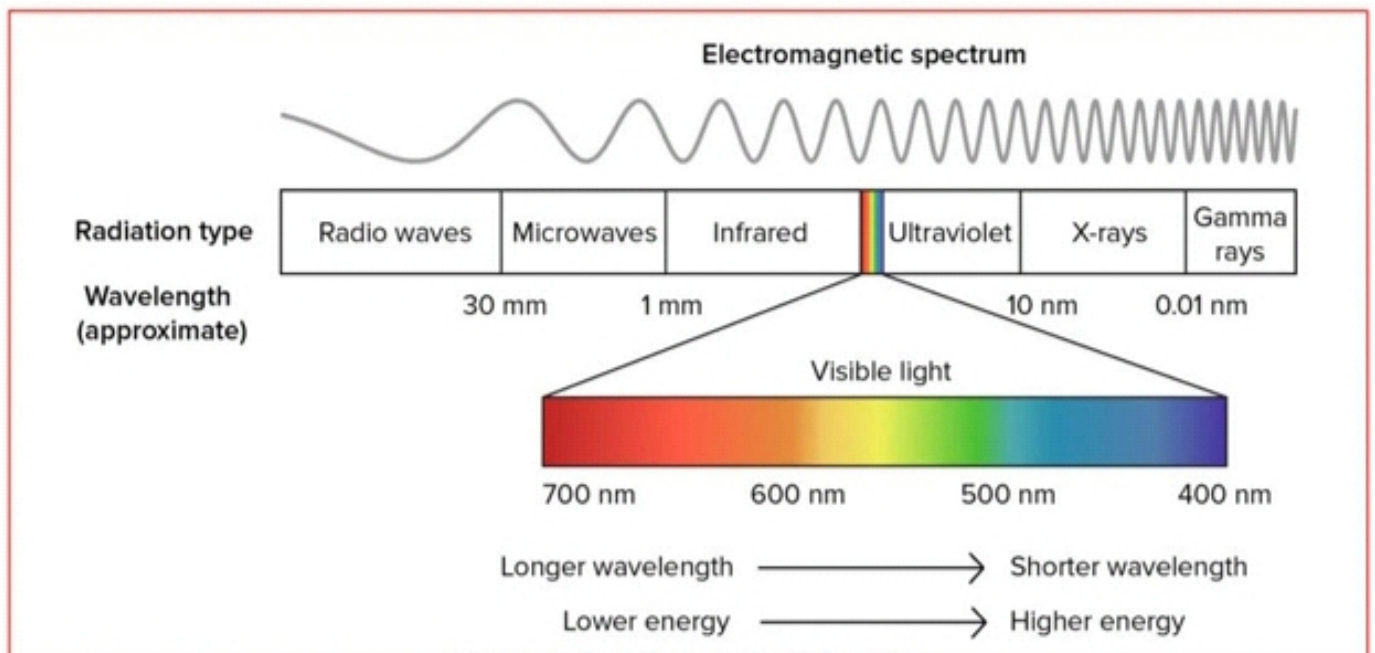
Electromagnetic Radiation(विद्युत चुम्बकीय विकिरण)

- to understand how EMR is produced, how it propagates through space, and how it interacts with other matter, it is useful to understand the electromagnetic energy using model below.
- In the 1860s, James Clerk Maxwell conceptualized as an EME or wave that travels through space at the speed of light, that is 299,792.46km/s or 186,282.03 miles/s(commonly rounded off to $3 \cdot 10^8$ m/s or 186,000 miles/s).
- The EMW consists of two fluctuating fields – one electric and the other magnetic .
- These two fluctuating fields are at right angles(90 degree) to one another, and both are perpendicular to the direction of propagation.

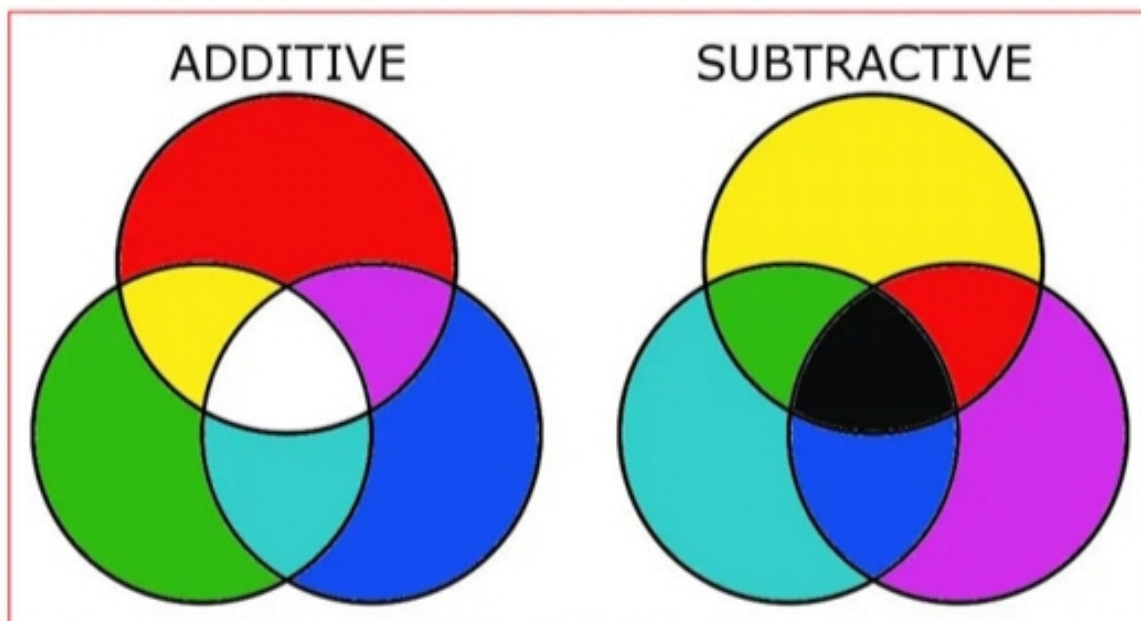


- Wavelength and frequency are the two important characteristics of EMR which are particularly important for understanding remote sensing.
- **Wavelength** - The length of one complete wave cycle, which can be measured as the **distance between two successive crests**. Represented by greek letter 'lambda' and it is measured in m, cm, mm, nm.
- **Frequency** – refers to the **number of cycles of a wave passing a fixed point per unit of time**. Represented by greek letter 'nu' and measured in 'hertz'(Hz).
- **Note** – *longer wavelength with lower frequency and shorter wavelength with higher frequency.*

Electromagnetic Spectrum(विद्युत चुम्बकीय वर्णक्रम)

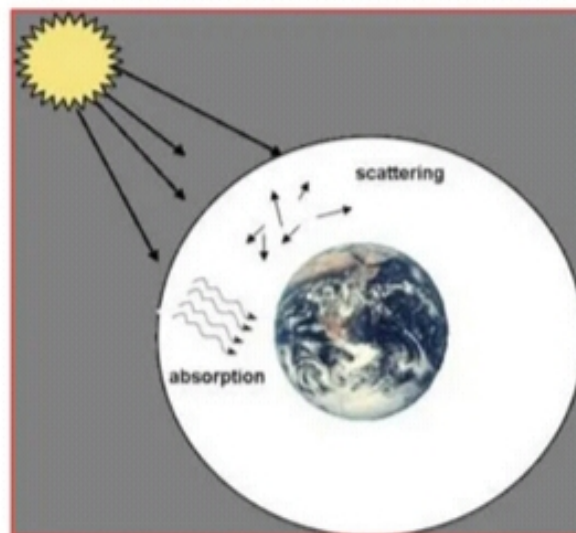


Primary colours in Visible band



2. Interaction with Atmosphere

- **Absorption**(अवशोषण)
- **Scattering** (बिखराव)
- **Refraction**(अपवर्तन)
- **Reflection**(परावर्तन)



a. Absorption of energy

- Absorption is the process by which radiant **energy is lost** or **converted into other form of energy**. The absorption of radiant energy may take place in the atmosphere and on the terrain.
- This is not desired **for remote sensing** as **no energy is available** to be sensed.
- **Ozone, carbon dioxide** and **water vapor** are the three main atmospheric constituents that absorb radiation.
- **Atmospheric windows** – those areas of the spectrum which are not severely influenced by atmospheric absorption and thus, are useful to remote sensor are called AWs.

b. Scattering

- **Unpredictable diffusion(direction)** of radiation by particles in the atmosphere. It occurs when particles or large gas molecules present in the atmosphere which interact with EMR and **redirected from its original path**.
- Scattering **depends** on **wavelength** of the radiation, the **diameter** of particles or **gaseous molecules**, and the **distance** the radiation travels through the atmosphere.
- **Types** – selective(Rayleigh, Mie and Raman) and non-selective scattering.

- **Rayleigh Scattering** – when the effective diameter of the matter is many times smaller (usually <0.1 times) than the wavelength of incident EMR.
- The amount of scattering is inversely related to the fourth power of wavelength of radiation. In upper atmosphere (4.5km)
- It is responsible for the blue appearance of the sky.
- **Mie scattering** – where, there may be many essentially spherical particles present with diameters approximately equal to the size of the wavelength of incident energy.
- **Raman scattering** – is caused by atmospheric particles, which are larger, smaller or equal to that of the wavelength of the radiation being sensed.
- **Non-selective scattering** – in the lowest portion of the atmosphere where there are particles greater than 10 times the wavelength of the incident EMR. NSS that is, all wavelengths of light are scattered, not just blue, green or red.

c. Refraction

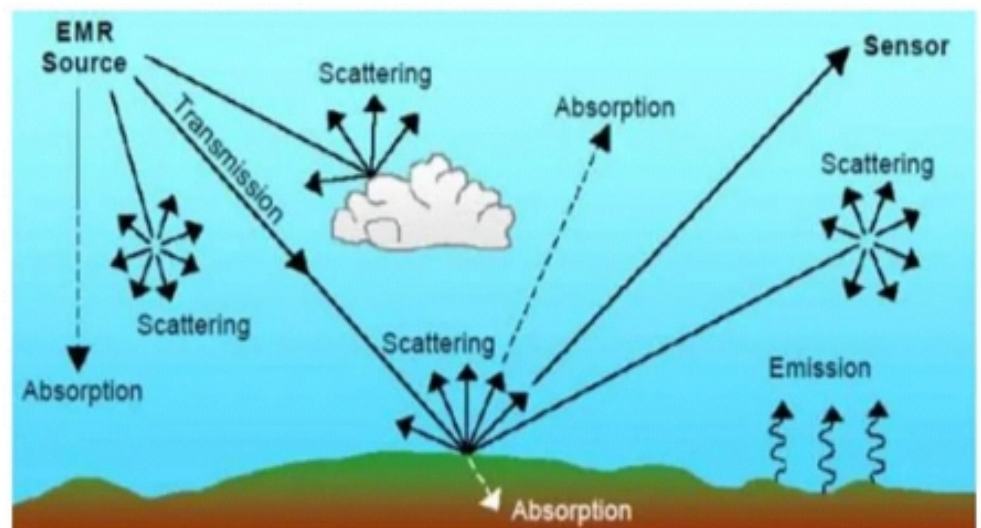
- When EMR encounters substances of different densities, like air and water, refraction takes place.
- Refers to the bending of light when it passes from one medium to another.

d. Reflection

- Reflection is the process whereby radiation 'bounces off' an object like the top of a cloud, a water body or the terrestrial earth. Reflection differs from scattering in that the direction associated with scattering is unpredictable but in case of reflection it is predictable.
- In this case angle of Incidence and the angle of reflection are approximately equal.
- Reflected energy is useful for RS but appearance of cloud on the imagery are the main problems associated with atmospheric reflection.

3. Interaction with the Target

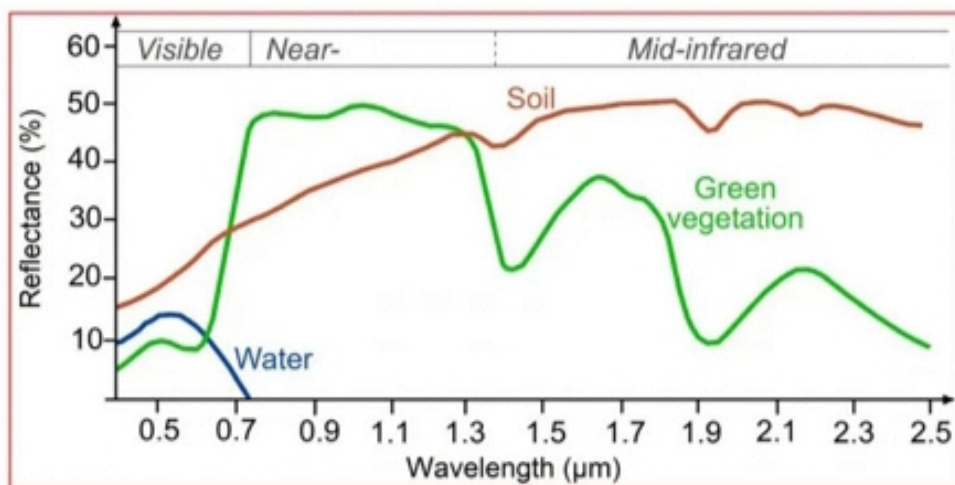
- Absorbed
- Transmission
- Reflection



Spectral Reflectance Curve

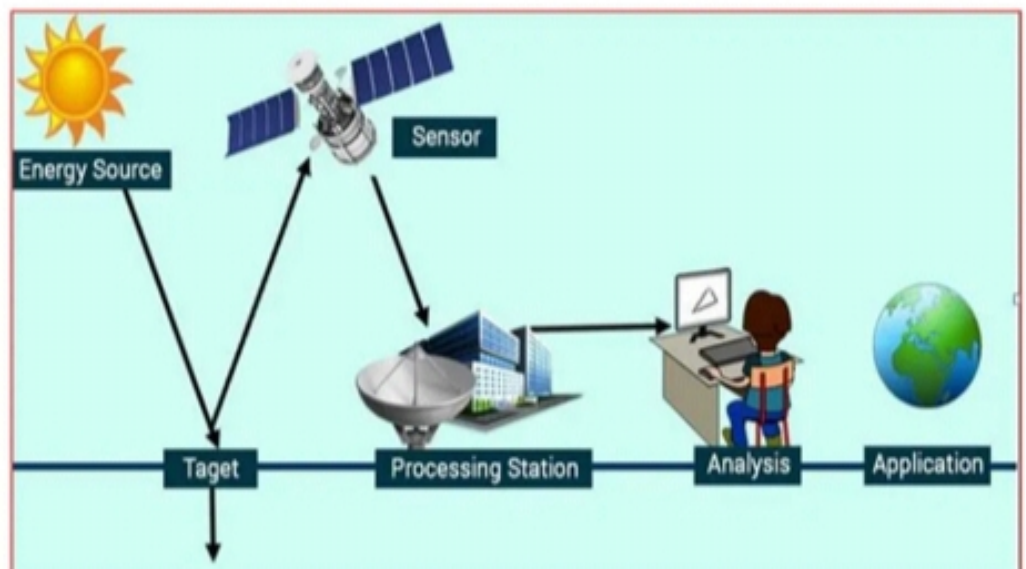
- **Spectral Reflectance** Curve shows the relationship of EMS with the associated percent reflectance for any given material. For any given material, **the amount of solar radiation that reflects, absorbs or transmits varies with wavelength**. This important property of matter makes it possible to identify different substances or classes and separate them by their spectral signatures(or spectral curves).
- We can distinguish the five common surface materials – **dry soil, wet soil, turbid river water, clear lake water, and vegetation**.
- **Note** – spectral reflectance curves typically provide no information about the absorption and transmittance of the radiant energy.

- **Signature** :- The nature of interaction of EMR with an object can lead to identifying the object. The **basic property** by which an **object can be identified** is called '**signature**'
- In RS, **spatial, spectral and temporal variations(signatures)** are the major characteristics to identify an object.



4. Interaction with the Atmosphere again

- Recording of energy by sensor



5. Transmission, Reception and Processing

- There are three main options for transmitting data acquired by satellites to the surface. The data can be directly transmitted to the earth if a Ground Receiving Station(GRS) is in the line of sight of the satellite.
- If this is not the case, the data can be recorded on TDRSS(tracking and data relay satellite system).
- In India, ISRO operates one GRS at **Shadnagar**, 55km away from **Hyderabad(AP)**. Shadnagar covers all of **India, Pakistan, Afghanistan, Bangladesh, Burma, Thailand** and portions of **Iran, Oman, Cambodia and Laos**.

6. Interpretation and Analysis

- **Visual image interpretation and**
- **Digital image interpretation.**

7. Application of Remote Sensing

- **Soil**
- **Hydrology**
- **Agriculture**
- **Medical image analysis(X-rays for broken arm)**
- **Earth resources information**
- **Urban planning**
- **Meteorology**
- **Weapons guidance**
- **Mapping science such as cartography**
- **GIS(geographical information system)**